APPLICATION NO. 10/806,016

INVENTION: Multi-scale code division frequency/wavelet multiple access

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WHAT IS CLAIMED IS;

Claim 1. (currently amended) A method for implementation of ~~new~~ multi-resolution complex Wavelet waveforms in the Fourier domain~~,~~ and ~~for implementation of new~~ orthogonal Wavelet division multiple access (OWDMA) filter banks, said method comprising:

~~Using complex extensions of the Wavelet concept to the Fourier frequency domain with addition of frequency translation as a Wavelet parameter to existing scale (dilation) and translation (shift) parameters for Wavelets;~~

~~using~~ deriving a single multi-resolution ~~complex~~ Wavelet implementation using design coordinates in the frequency domain to provide multi-resolution property for Wavelets at multiple scales~~,~~ ~~frequencies,~~ and translations;

changing said Wavelet to a complex Wavelet in the Fourier frequency domain by incorporating a frequency translation as a Wavelet parameter in addition to existing scale (dilation) and translation (shift) parameters;

~~using~~ deriving ~~a multi-resolution complex~~said complex Wavelet ~~implementation~~ with flexibility to meet filter design requirements;~~to circumvent a need to apply current methodology to use a Wavelet iterated filter bank construction to generate a Wavelet, and to apply current methodology to generate a Wavelet as a function of the scaling functions, and said implementation provides flexibility to meet application goals;~~

~~using~~ constructing ~~new orthogonal~~ OWDMA filters and filter banks ~~implemented~~ with ~~multi-resolution complex~~ said complex Wavelet channelization waveforms ~~generated in the Fourier domain,~~

~~and which can include analytical and iterated filter bank construction design techniques;~~

~~using implementations for orthogonal OWDMA filters and filter banks~~ over ~~contiguous and non-contiguous~~ frequency bands~~,~~ for simultaneous multi-resolution OWDMA filters at different scales and different frequencies and different symbol rates~~, and said implementations using multi-resolution complex Wavelet channelization waveforms generated in the Fourier frequency domain and which can include analytical and iterated filter bank construction techniques~~;

~~using~~ using said complex Wavelet to generate ~~a mother~~ multi-resolution mother Wavelet at dc ~~in the Fourier~~using design coordinates in the frequency domain which enable the generation of ~~and constructing~~ a desired multi-resolution complex Wavelet ~~from said mother Wavelet~~ using appropriate scale, frequency, and translation changes to the mother Wavelet; and

implementing said OWDMA filters in a communications transmitter and in a communications receiver for a communications link.

Claim 2. (currently amended) A method for implementation of ~~new~~ multi-scale complex code division multiple access (MS-~~CDMA~~ CDMA) encoding and decoding over multiple scales where each scale corresponds to an independent communications parameter, said method comprising:

~~which MS-CDMA encoding includes the complex pseudo-noise spreading or covering, and which MS-CDMA decoding includes removal of this complex pseudo-random spreading or covering, said method comprising:~~

~~using complex orthogonal MS-CDMA encoding spreading over a frequency band with a lower chip rate than the chip rate using current CDMA encoding;~~

~~using complex orthogonal MS-CDMA encoding spreading over a non-contiguous frequency band with a lower chip rate than the chip rate using current CDMA encoding;~~

~~using power level control of the transmitted signal as a function of the frequency over the frequency band;~~

~~using fast complex MS-CDMA encoding and decoding over multiple scales, and which MS-CDMA includes the complex pseudo-noise spreading or covering and the removal of the complex pseudo-random spreading or covering;~~

generating ~~partitioning the frequency band into~~ independent subbands or groups of subbands over a frequency band; ~~and MS-CDMA encoding and spreading the users over these subbands or groups of subbands;~~

~~partitioning the frequency band into independent subbands or groups of subbands, assigning users to the subbands or groups of subbands, and MS-CDMA encoding and spreading the users within their assigned subbands or groups of subbands;~~

~~implementing~~ generating a 2 scale MS-CDMA code and assigning the subbands over a frequency band into MS-CDMA groups, MS-CDMA encoding and spreading each user in each group such that each user is spread within each subband in the MS-CDMA group in a scale "0" encoding and spreading, each user in each group is spread over the subbands of the MS-CDMA group in a scale "1" encoding~~,~~ and spreading;

~~and implementing fast encoding and decoding algorithms;~~

~~using a Kronecker product (tensor product) for generating~~ constructing a complex orthogonal 2-scale MS-CDMA code matrix as a Kronecker product (tensor product) of a subband complex orthogonal MS-CDMA code matrix for scale "0" encoding and spreading and a wideband complex orthogonal MS-CDMA code matrix for scale "1" encoding and spreading~~,~~ ; ~~and implementing fast encoding and decoding algorithms,~~

~~using Kronecker product (tensor product) for generating~~

constructing a complex orthogonal N-scale MS-CDMA code matrix as a Kronecker product of orthogonal complex MS-CDMA code matrixes for each of the MS-CDMA scales "0", "1", . . , "N-1", with each scale assigned to an independent communications parameter, with each scale performing encoding and spreading of the users~~, ; and~~

~~implementing~~

~~fast encoding and decoding algorithms,~~

~~using~~ constructing an algebraic field factorization and scaling to convert a CDMA code matrix to a 2-scale CDMA code ~~matris~~ matrix by

generating a CDMA code with a code length equal to a product of a number of chips for a first scale "0" CDMA encoding having first code and chip indices used to encode data symbols within each subband, and a number of chips for a second scale "1" CDMA encoding having second code and chip indices used to encode data symbols over the entire set of subbands,

forming a 2-scale CDMA code by assigning code and chip indices such that the 2-scale CDMA code and chip indices are the algebraic addition of the first scal~~,~~e "0" code and chip indices plus scaled second scale "1" code and chip indices, wherein said scaled indices are generated using a scale factor that comprises the number of indices in the first scale CDMA code,

wherein the steps of generating and forming further include encoding data symbols with the 2-scale CDMA code to generate encoded chips,

assigning each of the encoded chips to a subband in accordance with the second scale "1" CDMA code indices, assigning each encoded chip to a chip position within its assigned subband in accordance with the first scale "0" CDMA code indices~~, and encoding with pseudo-noise covering~~, and generalizing said implementation to scales "0", "1",

. . , "N-1" for an N-scale MS-CDMA code matrix with each scale assigned to an independent communications parameter, with each scale performing encoding and spreading of the users~~,~~ ; ~~and~~

encoding ~~implementing fast encoding~~ and decoding MS-CDMA with fast algorithms;

controlling the power level the transmitted signal as a function of the frequency over the frequency band; and

implementing said N-scale MS-CDMA in a communications transmitter and in a communications receiver for a communications link.

Claim 3. (currently amended) A method for implementing ~~new multi-scale complex code division multiple access~~ MS-CDMA orthogonal frequency division multiple access (OFDMA) communications and~~,~~ for implementing ~~new~~ MS-CDMA ~~orthogonal Wavelet division multiple access~~ OWDMA communications, ~~which MS-CDMA encoding includes pseudo-noise complex spreading or covering, and which MS-CDMA decoding includes removal of this pseudo-random complex covering or spreading,~~ said method comprising:

~~using MS-CDMA encoding and spreading of users over OFDMA or OWDMA channels in a frequency band which may be non-contiguous;~~

~~using MS-CDMA encoding and spreading of users in OFDMA or OWDMA channels over a frequency band which may be non-contiguous;~~

~~using MS-CDMA encoding and spreading of the users within each OFDMA or OWDMA channel and over all of OFDMA or OWDMA channels such that each user is in each OFDMA or OWDMA channel;~~

~~implementing fast encoding and decoding algorithms for complex MS-CDMA;~~

~~implementing fast algorithms for a multi-resolution complex Wavelet transform for OWDMA encoding and implementing fast algorithms for multi-resolution complex Wavelet transforms for OWDMA decoding;~~

assigningusing ~~a 2 scale MS-CDMA~~ OFDMA or ~~MS-CDMA~~ OWDMA ~~assigning~~ users to channel groups and MS-CDMA encoding and spreading each set of users in these groups with a 2 scale MS-CDMA, code ~~,~~ such that each user in a group is spread over all of the channels in a group in a scale "1" encoding and spreading, and is spread within each channel of a group in a scale "0" encoding and spreading~~, and implementing fast encoding and decoding algorithms~~;

constructingusing a MS-CDMA code matrix with a Kronecker product ~~for constructing a complex orthogonal multi-scale MS-CDMA code matrix~~ for encoding spreading at each of the scales, with each scale assigned to an independent communications parameter, with each scale performing encoding and spreading of the users, and with one or more scales assigned to OFDMA or ~~OWDNA~~OWDMA;

~~using an algebraic field factorization and scaling for~~ constructing a complex orthogonal multi-scale MS-CDMA code matrix for encoding spreading at each of the scales with a scaled algebraic field, with each scale assigned to an independent communications parameter, with each scale performing encoding and spreading of the users, and with one or more scales assigned to OFDMA or ~~OWDNA~~OWDMA;

encoding and decoding MS-CDMA,OWDMA, and OFDMA with fast algorithms; and

implementing said MS-CDMA OFDMA and MS-CDMA OWDMA filters in a communications transmitter and in a communications receiver for a communications link.